

Comparison of Crop Productivity in Central North Dakota

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★ ABSTRACT

Crop diversity in the Northern Great Plains has increased in recent decades as new alternative crops have been researched and successfully commercialized. The number of viable crop options is especially significant in the central region of North Dakota. Crop adaptation and variety trials conducted at the Carrington Research Extension Center provide an environment and an opportunity to compare relative crop adaptation and performance of most crops grown in the region. Annual field trials evaluate agronomic traits and the performance potential of more than 30 crops that are commercially grown in central North Dakota. Highest grain yield and stability in performance were associated with traditional crops such as spring wheat, sunflower, barley, durum, oats, and dry edible bean. New alternative crops and other minor crops such as field pea, flax, safflower, winter rye, and spring triticale have also produced high and stable yields. Corn, soybean, canola, crambe, and buckwheat have exhibited excellent crop adaptation, however yield fluctuation across years has been higher. Wide variances in crop performance are associated with lentil, chickpea, lupin, proso millet, and mustard. These comparisons of crop productivity identify crop contrasts due to inherent differences in adaptation to the environment of central North Dakota.



Chickpea



Durum



Flax

★ INTRODUCTION

The Carrington Research Extension Center (CREC) is one of six out-state centers at North Dakota State University that conducts field trials to evaluate crop adaptation and cultivar performance. The specific crops evaluated at each center are influenced by the environment represented by that location and the inherent or potential adaptation of a crop. Crop performance is determined by comparing a basic set of factors that include seed yield, crop quality, phenology, and agronomic parameters. The primary crops of the state and region are evaluated each year, while other crops are studied based on interests due to advances in adaptation and industry requests.

The extensive number of field crops evaluated in the variety trials at the CREC represents a unique opportunity to compare the relative performance of a biologically diverse set of field crops. Generally, agronomists and other agricultural interests are only able to review crop performance among a relatively small number of crops within a specific area or region. Data from these trials at one location over a sixteen year period provide an opportunity to compare relative crop performance among crops that are important across many regions of the United States.



Canola



Oat



Dry Edible Bean



Buckwheat



Field Pea



Barley



Sunflower



Lentil



Triticale



Lupin

★ MATERIALS AND METHODS

The CREC is located in a region of North Dakota that represents soils and climatic conditions favorable for the production of most crops grown in the Northern Plains. The climatic attributes of the Carrington site are as follows: Mean annual temperature, 4.2° C; Mean annual precipitation, 442 mm; Mean seasonal (May-August) cumulative degree days at 5° C base, 1490; Frost free days in growing season, 132; Latitude, 47.51° North; Longitude, 99.12° West; and Elevation, 493 m. The soil type at Carrington is a Heimdal loam (coarse-loamy, mixed, frigid, Udic Haploborolls).

Each year the CREC agronomists consult with NDSU plant breeders, national and international seed company representatives, private plant breeders, USDA breeders, and other land grant university scientists to determine the best array of cultivars to represent a crops potential in central North Dakota. Crop variety trials are planted under dryland conditions on land with crop history appropriate for the biology of the specific crop. Best management practices are used on all crops and each crop is planted on land with identical soil types. Fields utilized for these trials are all within 1 km, so climatic conditions are considered equal and representative of the growing season. Generally the CREC will evaluate 25 to 30 field crops annually and most performance trials include 10 to 80 cultivars. The crops with lower numbers of cultivars in the trial tend to be crops with limited adaptation, suggesting breeding programs would be advantageous.

Table 1. Crops represented in review of crop productivity, Carrington, N.D.

Crop	Scientific Name	Maximum Annual State Plantings (1993-2003) (ha)
Spring Wheat	<i>Triticum aestivum</i> L.	3,749,703
Durum	<i>Triticum turgidum</i> L.	1,382,113
Barley	<i>Hordeum vulgare</i> L.	1,074,499
Corn	<i>Zea mays</i> L.	502,923
Oat	<i>Avena sativa</i>	290,329
Proso Millet	<i>Panicum miliaceum</i> L.	42,768
Rye (winter)	<i>Secale cereale</i>	23,802
Triticale (spring)	<i>Triticale hexaploide</i> Lart.	2,157
Sunflower (oil)	<i>Helianthus annuus</i> L.	627,415
Canola	<i>Brassica napus</i> or <i>campestris</i>	523,757
Flax	<i>Linum usitatissimum</i> L.	300,540
Mustard	<i>Brassica alba</i> & <i>juncea</i>	53,049
Safflower	<i>Carthamus tinctorius</i>	22,888
Crambe	<i>Crambe abyssinica</i> H.	25,422
Soybean	<i>Glycine max</i> L.	1,253,564
Dry Edible Bean	<i>Phaseolus vulgaris</i> L.	315,610
Field Pea	<i>Pisum sativum</i> L.	63,827
Lentil	<i>Lens culinaris</i> Medik.	22,000
Chickpea	<i>Cicer arietinum</i> L.	7,685
Lupin	<i>Lupinus albus</i> L.	340
Buckwheat	<i>Fagopyrum sagittatum</i> G.	16,591



Proso Millet



Crambe



Rye

Table 2. Comparisons of seed yield (kg ha⁻¹) from selected crops evaluated at the Carrington Research Extension Center, 1987 - 2002.

Crop	2002	2001	2000	1999	1998	1997	1996	1995	1994	1993	1992	1991	1990	1989	1988	1987
<i>Grasses</i>																
HRSW	2513	3293	3199	3078	3575	3575	2822	2520	3703	3179	3656	2493	3387	1566	1667	3084
Durum	2675	2124	2715	3521	3326	2554	2204	2070	3078	2056	3407	2439	4072	1579	1593	2822
Barley	3683	4037	3263	4602	5193	4027	3634	3989	4688	4306	4543	3414	3478	2140	1430	2753
Corn	6404	9439	6905	7482	4441	7740	6780	6630	6504	1650	2095	7997	6002	3713	2051	6272
Oat	2383	NA-A	3695	4469	4042	3581	3882	3692	4541	2968	4165	2882	4175	2649	1656	2731
Proso Millet	1085	2355	2146	3173	1360	2243	3496	2912	1881	NA-A	1918	2851	3870	2949	658	907
Winter Rye	NA-A	3412	3989	2854	3569	2026	1668	2797	2728	4679	3914	2622	4008	2935	2749	2402
Spring Triticale	2610	2559	2828	4217	2363	2453	3875	3046	3674	2990	2873	2985	3528	1411	1025	NA-A
<i>Oilseeds</i>																
Sunflower	2358	2351	2416	2803	2568	2603	2918	2320	2274	2116	1151	2247	1920	1844	2337	2187
Canola	1547	2609	1975	1928	2300	2494	2211	1911	2823	1251	1530	1034	1724	1009	237	1623
Flax	1599	1392	1116	1825	2346	1267	1499	1499	1073	627	1167	1725	1223	NA-A	721	1386
Mustard	610	1811	1142	1364	1701	2228	1438	1876	2464	571	1704	1503	1355	1045	792	1235
Safflower	2103	1052	NA-A	1322	1325	1748	1243	1305	1149	256	1574	1140	1487	782	770	1017
Crambe	1796	1941	944	1234	2211	2236	1870	2098	2461	1509	2150	1028	2100	1078	1499	NA-A
<i>Legumes</i>																
Soybean	2796	3219	3132	2688	2083	2325	2191	2083	2224	1337	1109	1512	1660	1559	1331	2531
Dry Edible Bean	2136	1980	2584	2526	1897	2243	2153	2023	2358	1729	978	2556	1585	988	584	2690
Field Pea	3515	3716	3387	4066	3165	5060	4650	1802	3910	2433	3527	3281	3195	1547	NA-A	NA-A
Lentil	1495	NA-B	1366	1335	1651	NA-B	222	56	1766	385	2365	836	1240	1581	1277	955
Chickpea	3053	1357	756	692	2317	NA-B	1174	802	583	54	2193	2053	3601	1370	NA-A	262
White Lupin	1210	2332	2715	2500	NA-B	NA-B	2439	269	954	148	2601	1613	3128	1828	954	NA-A
<i>Miscellaneous</i>																
Buckwheat	1702	1252	1062	2607	1357	1036	452	1073	539	1893	1354	731	1559	1891	187	1133
NA-A: Crop variety trial was not planted. NA-B: Crop failure due to disease pressure.																



Mustard



Soybean



Corn

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★ RESULTS AND DISCUSSION

★ Traditionally planted crops such as spring wheat, durum, barley, oat, sunflower, and dry edible bean provided high grain yield and stable performance (Figure 1).

★ New alternative crops such as field pea and spring triticale along with traditionally planted minor crops of winter rye, flax, and safflower also produced competitive and stable yields (Figure 2).

★ Corn, soybean, canola, crambe, and buckwheat have exhibited excellent crop adaptation, however crop performance has varied significantly (Figure 3).

★ Wide variations in crop performance are associated with proso millet, mustard, lentil, chickpea, and lupin. This suggests limited crop adaptation and/or a greater need for improved crop varieties (Figure 4).



Spring Wheat



Safflower

Figure 1. Traditional crops with high yield and stable performance.

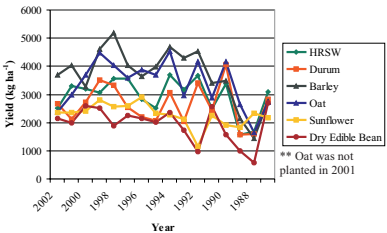


Figure 2. New alternative crops with competitive and stable yields.

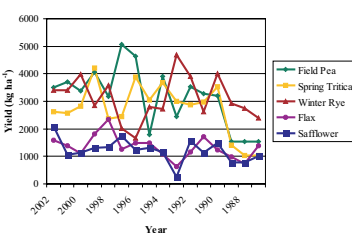


Figure 3. Crops with excellent adaptation and variable performance.

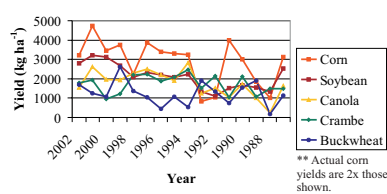
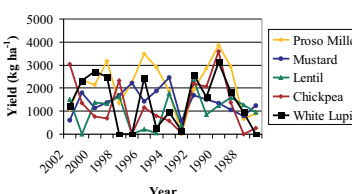


Figure 4. Crops with high variability suggesting limited adaptation.



★ SUMMARY

★ The annual evaluation of a broad array of field crops across numerous growing seasons provides an opportunity to compare the relative performance of many of the crops grown in the Northern Plains.

★ Review of the crop performance data across years indicates that seed yields differed greatly among crops and that crops varied significantly in the stability of performance.

★ Generally, crops with more stable performance were those with strong regional plant breeding programs and the cool-season crops except for sunflower and dry edible beans, which are indigenous to this region.

★ These data reflect crop performance based on a seed yield only. Differences in crop market prices, crop management criteria, and production economics influence a crops fit in cropping systems of the region.

★ Performance of a diverse set of field crops across years suggests that farmers in central North Dakota have a significant number of viable crop options.

